Randall Hellman, Ph.D.
RH Mechatronics, LLC

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Summary

I am a mechatronics engineer who loves solving complicated problems in creative ways. I have contributed to the advancement of robot haptics in the areas of perception, decision-making, and manipulation tasks using innovative custom hardware and software systems. I have experience in the medical device, aerospace, automotive, and energy industries. I pride myself on learning new tools quickly and applying them to solve complex problems. I have a proven record of leading teams to develop novel mechatronic devices.

Experience

2021 - Present

RH Mechatronics, LLC, Los Angeles, CA

Owner & Principal **Mar. 2021 - Present**

* Provide a full range of mechatronics consulting focusing on wearables, robotics, and sensor development.
* Completed full electrical design and firmware development of a BLE wearable device for a publicly-traded company. The wearable device is currently being manufactured at scale.
* Brought on to determine the root cause of failures which required a complete redesign of consumer electronic devices along with production improvements.

2020 - 2021

Ubtech North American R&D Center, Pasadena, CA

Staff Mechatronics Engineer **Feb. 2020 - Mar. 2021**

* Led a multidisciplinary team in the electromechanical development of robotic systems for healthcare facilities.
* Developed sensing solutions for IR and sonar sensors. Includes the firmware and bring up.

2019 - 2020

HaptiBot, Los Angeles, CA

Founder **Mar. 2019 - Jan. 2020**

* Early-stage startup developing prototypes of wearable input devices that provide haptic feedback to VR/AR users.

2017 - 2019

Verb Surgical (now J&J Robotics & Digital Solutions), Mountain View, CA

Senior Mechatronics Engineer **Oct. 2018 - Mar. 2019**

* Drove new concepts and delivered functional prototypes.

Mechatronics Engineer **Nov. 2017 - Oct. 2018**

* Developed prototypes for control of surgical robotic system along with meaningful contributions to the mechanical and sensing strategies.

2017

Modbot, San Francisco, CA

Robotics and Controls Engineer **Mar. 2017 - Nov. 2017**

* Developed control algorithms for EtherCat servo controller written in XC.
* Create C/C++ ROS node for system-level inspector and tuning.
* Implement sampling-based planning algorithms for the control of modular robots.
* Actualize hard real-time with RT Preempt for all-time critical cyclic control loops.

2016-2017 **Biomechatronics Laboratory, University of California, Los Angeles**

Postdoctoral Research Associate **Aug. 2016 - Mar. 2017**

Developed systems for haptic search and retrieval of objects buried within granular material.

2014-2016 **Biomechatronics Laboratory, University of California, Los Angeles**

Visiting Graduate Scholar **Jun. 2014 - Mar. 2018**

Built systems for functional contour-following via haptic perception and reinforcement learning.

2008–2011 **Kiewit Energy, Houston, TX**

Field Engineer **Dec. 2008 - Jan. 2011**

Developed a site tracking and progress database for a $300 million refinery upgrade.
Assembled research-informed reports on the development and technology of the LNG supply chain for entry into new markets.

Specialties

Software

* CCStudio, STM32CubeIDE, IAR, ROS, TensorFlow, OpenCV, Matlab, Xcode

Design Software

* Solidworks, Fusion360, Altium,

Languages

* C/C++, Python, Swift, Objective C

Skills

* Mechatronic device prototyping and design, firmware, machine learning, reinforcement learning, robot sensor design, hard real-time programming, design for manufacturing, machining and manufacturing techniques, multirotor, BLDC motor controllers, digital control systems, rapid prototyping, embedded system design, PCB design & layout

Education

2016 **Ph.D. Mechanical and Aerospace Engineering, Arizona State University**

“Haptic Perception, Decision-making, and Learning for Manipulation with Artificial Hands”

2015 **M.S. Mechanical and Aerospace Engineering, Arizona State University**

2008 **B.S. Mechanical Engineering, Purdue University**

Awards

2016 **Best poster award finalist,** Southern California Robotics Symposium
"Haptic Perception and Decision-making for a Functional Contour-Following Task"

2016 **Best poster award,** UCLA, Industrial Advisory Board
"Haptic Perception and Online Policy Learning for Robot Hands"

2014 **Travel Fellowship,** Arizona State University Graduate College

2013 **University Graduate Fellowship,** Ira A. Fulton Schools of Engineering

2008 **1st Place Malott Innovation Award,** ME Senior Design, Purdue University
Team leader for senior design group project, "Hangar Mate," a tow device capable of maneuvering a small aircraft until the plane could taxi on its own. https://www.youtube.com/watch?v=U6u-OtfJN9I

Patents

Miller D.A., Hellman, R.B. and Savall J. "Drop Detection of Ungrounded Master Controller for a Surgical Robot" WO Pub. No. WO2021/188127 A1, Sep. 23, 2021

Savall J., DeMartini R.E., Hellman, R.B., Miller D.A., Von Kapri, A., and Garcia P. "Wearable User Interface Device" WO Pub. No. WO2020/154012 A1, Jul. 30, 2020

Santos, V.J. and Hellman, R.B. "Systems and methods for tendon-driven robotic mechanisms." Pub. No. US 2019/0001487 A1, Jan. 3, 2019

Journal Publications

Hellman, R.B., Tekin, C., van der Schaar, M., & Santos, V.J. (2017). "Functional contour-following via haptic perception and reinforcement learning." *IEEE transactions on haptics*, *11*(1), 61-72.

Overstreet, C.K., **Hellman, R.B.**, Ponce Wong, R.D., Santos, V.J., and Helms Tillery, S.I. "Discriminability of Single and Multichannel Intracortical Microstimulation within Somatosensory Cortex." *Frontiers Bioeng. Biotechnol. 2016:4:91.* doi: 10.3389/fbioe.2016.00091.

Hellman, R.B., Chang, E., Tanner, J., Helms Tillery, S.I., and Santos, V.J. "A robot hand testbed designed for enhancing embodiment and functional neurorehabilitation of body schema in subjects with upper limb impairment or loss." *Front. Human Neurosci., Special Issue on "Proprioceptive dysfunction, related motor disorders and their neurological (robotic) rehabilitation" 2015:9(26):1-10.* doi: 10.3389/fnhum.2015.00026.

Ponce Wong, R.D., **Hellman, R.B.**, and Santos, V.J. “Spatial asymmetry in tactile sensor skin deformation aids perception of edge orientation during haptic exploration.” *IEEE Transactions on Haptics in March 2014. Special Issue on “Haptics in Rehabilitation and Neural Engineering,” 2014:7(2):191–202.*

Archival Conference Proceedings

Ponce Wong, R.D., **Hellman, R.B.** and Santos, V.J. “Haptic exploration of fingertip-sized geometric features using a multimodal tactile sensor.” *Proc SPIE Defense, Security and Sensing / Sensing Technology and Applications “Sensors for Next-Generation Robotics” Conference, Baltimore, MD, May 5-9, 2014. Podium.*

Hellman, R.B. and Santos, V.J. “Design of a back-driveable actuation system for modular control of tendon- driven robot hands.” *Proc IEEE RAS/EMBS Intl Conf on Biomedical Robotics and Biomechatronics, Roma, Italy, June 24-27, 2012. Podium.*

Refereed Conference Proceedings

Hellman, R.B. and Santos, V.J. “Haptic Perception and Decision-Making for a Functional Contour-Following Task.” *IEEE Haptics Symposium, Work-in-progress paper, Philadelphia, PA, April 8-11, 2016.*

Hellman, R.B. and Santos, V.J. “Development of probabilistic models for real-time perception of geometric features with a sensorized artificial finger.” *Workshop on “Robotic Hands, Grasping and Manipulation,” IEEE/RAS Intl Conf on Robotics and Automation, Seattle, WA, May 30, 2015.*

Hellman, R.B., Chang, E., Tanner, J., Helms Tillery, S.I., and Santos, V.J. “A robot hand testbed for enhancing embodiment and functional neurorehabilitation of body scheme in upper limb amputees.” *Myoelectric Controls Symposium, New Brunswick, Canada, Aug. 18-22, 2014.*

Hellman, R.B., Chang, E., and Santos, V.J. “Tendon-driven testbed for haptic exploration and sensory event-driven grasp and manipulation.” *IEEE Haptics Symposium, Houston, TX, Feb. 23-26, 2014, Hardware demonstration D78.*

Overstreet, C.K., Ponce Wong, R.D., **Hellman, R.B.**, Santos, V.J., and Helms Tillery, S.I. “Discrimination of multichannel ICMS driven by a tactile sensor.” *Proc Ann. Mtg. of Soc for Neuroscience, San Diego, CA, Nov. 9-13, 2013.*

Conference Proceedings

Hellman, R.B. and Santos, V.J. “Haptic perception, decision-making, and reinforcement learning for manipulation of a deformable object.” *NSF National Robotics Initiative PI Mtg, Arlington, VA, Nov. 5-6, 2015.*

Hellman, R.B., Ponce Wong, R.D., and Santos, V.J. *“Haptic exploration and decision making with a highly sensorized robot hand.” UCLA Engineering Tech Forum – “Robotics and Technologies of the Future,” University of California, Los Angeles, Feb. 3, 2015.*

Ponce Wong, R.D., **Hellman, R.B.,** and Santos, V.J. “Context-driven haptic inquiry of objects based on task requirements for artificial grasp and manipulation.” *NSF National Robotics Initiative PI Mtg, Arlington, VA, Nov. 19-20, 2014.*

Chang, E., **Hellman, R.B.,** and Santos, V.J. “Development of an anthropomorphic robot hand testbed for artificial grasp and manipulation.” *Proc Fulton Undergrad. Res. Symp., Arizona State University, Tempe, AZ, April 11, 2014.*

Hellman, R.B., Chang, E., Tanner, J., Helms Tillery, S.I., and Santos, V.J. “Tendon-driven testbed for haptic exploration and sensory event-driven grasp and manipulation.” *Piper Health Solutions Workshop on Rehabilitation Robotics, Tempe, AZ, Feb. 28 - Mar. 1, 2014.*

Hellman, R.B., Chang, E., Tanner, J., Helms Tillery, S.I., and Santos, V.J. “Tendon-driven testbed for haptic exploration and sensory event-driven grasp and manipulation.” *DARPA MTO Sensorimotor Prosthetics Workshop, Scottsdale, AZ, Feb. 13, 2014.*

Overstreet, C.K., **Hellman, R.B.,** Ponce Wong, R.D., Helms Tillery, S.I., and Santos, V.J. “CPS challenges in human-machine interfaces: Context-dependent control of smart artificial hands through enhanced touch perception and mechatronic reflexes.” *NSF Cyber-Physical Systems PI Meeting, Arlington, VA, Oct. 17-18, 2013.*

Ponce Wong, R.D., **Hellman, R.B.,** and Santos, V.J. “Context-driven haptic inquiry of objects based on task requirements for artificial grasp and manipulation.” *NSF National Robotics Initiative PI Meeting, Arlington, VA, Oct. 1-2, 2013.*

Hellman, R.B. and Santos, V.J. “Design of a remote actuation module with self-contained, direct tendon force sensing for artificial hands.” *Piper Health Solutions Workshop on Rehabilitation Robotics, Tempe, AZ, Feb. 22-23, 2013.*

Ponce Wong, R.D., **Hellman, R.B.,** and Santos, V.J. “Use of multimodal tactile sensor data for artificial grasp and manipulation.” *Piper Health Solution Workshop on Rehabilitation Robotics, Tempe, AZ, Feb. 22, 2013.*

Tanner, J., **Hellman, R.B.,** Helms Tillery, S.I., and Santos, V.J. “CPS challenges in human-machine interfaces: Context-dependent control of smart artificial hands through enhanced touch perception and mechatronic reflexes.” *NSF Cyber-Physical Systems PI Meeting, National Harbor, MD, Oct. 3-5, 2012.*

Invited Talk

"Development of Haptic Perception and Manipulation Capabilities for Robot Hands,"
Interaction Lab, University of Southern California, Los Angeles, CA, December 2015.

Editorial Experience

Journal of Biomechanics, Robotica

Teaching Experience

Guest Lecturer

* Systems and Controls (Spring 2014): Undergraduate, junior level
* Mech Design/Control Robots (Fall 2013): Graduate level

Instructor

* Thermofluids I (Undergrad Spring 2012)

Media Coverage (highlights)

2016	ScienceNews, "For robots, artificial intelligence gets physical" (https://www.sciencenews.org/article/robots-artificial-intelligence-gets-physical?tgt=nr)
2016	Front page article on Daily Bruin, "UCLA lab working to create machines that simulates touch" (http://dailybruin.com/2016/04/17/ucla-lab-working-to-create-machine-that-simulates-touch/)
2015	PCMag article titled, "Up close with the 'BairClaw' robot hand" (http://www.pcmag.com/article2/0,2817,2484955,00.asp)
2015	National Science Foundation Science Nation video titled, *"Giving robots and prostheses the human touch,"* as part of National Robotics Week. Video: https://youtu.be/Qmyri62ISKo
2013	Educational television show, *"STEM Journals,"* Phoenix, AZ featured in a "biomechanics" episode. Video: http://www.cox7.com/biomechatronics
2013	Arizona State University Alumni Mag., Vol. 14, Featured as part of an article on biomimicry